HCAL Noise and Problematic Channels Treatment

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Outlook

- Noise in FastSimulation
- Noise in Full Simulation
- Noise Zero Suppression
- Occupancies
- Problematic channels detection
- Problematic channels treatment

Noise in FastSimulation

- Gaussian uncorrelated, subsystem-unified noise
  - No time slices (Digis) for RecHits evaluation
  - Effective mean values borrowed from FullSim RecHits applied at the RecHit level
- Fast “over threshold” noise simulation
  - Efr(x) calculation of the fraction (number) of cells above threshold (“Scheme B” !) in each subsystem
  - Poisson smearing of the expected number of such cells Nc for each subdetector
  - Injection of noise in randomly chosen Nc cells
  - Injection of noise in “fired” (with real signal) cells, excluding those already treated above

Noise in Full Simulation

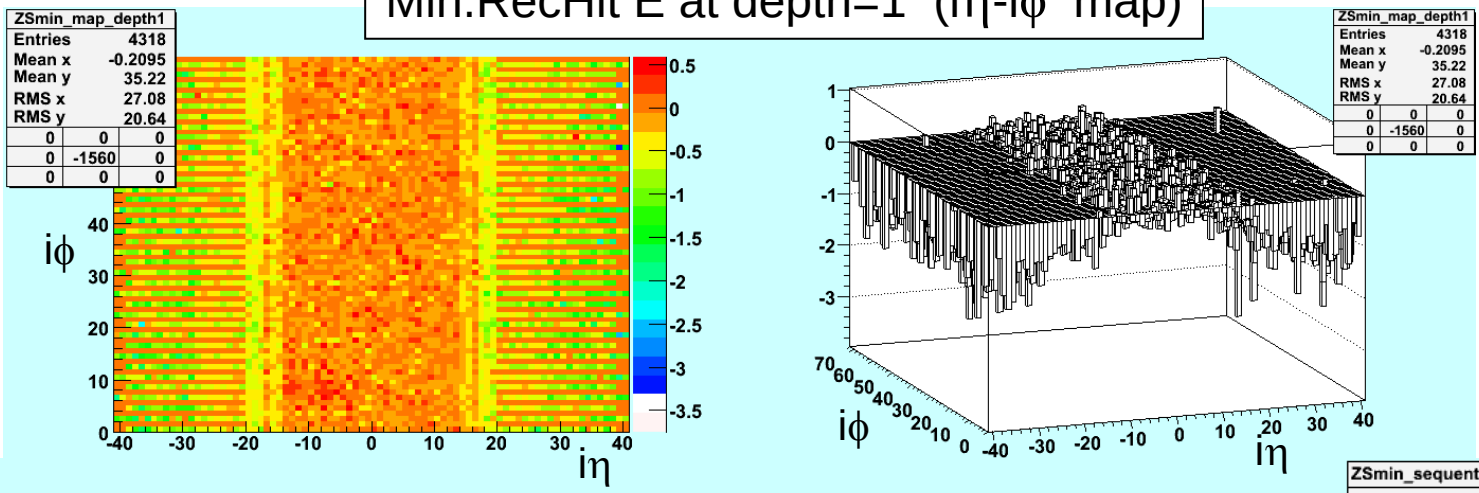
- Gaussian correlated, unique for each Readout
  - There is a correlation between time slices (ts), as there are 4 capacitors (with unique CapId) in each channel, which are used sequentially for each ts
  - Current RecHits evaluation uses 4 ts, so that all 4 CapId's are involved
  - Each CapId has slightly different characteristics
- Noise is evaluated from in situ data (UX5) and uploaded to DB

Noise Zero Suppression

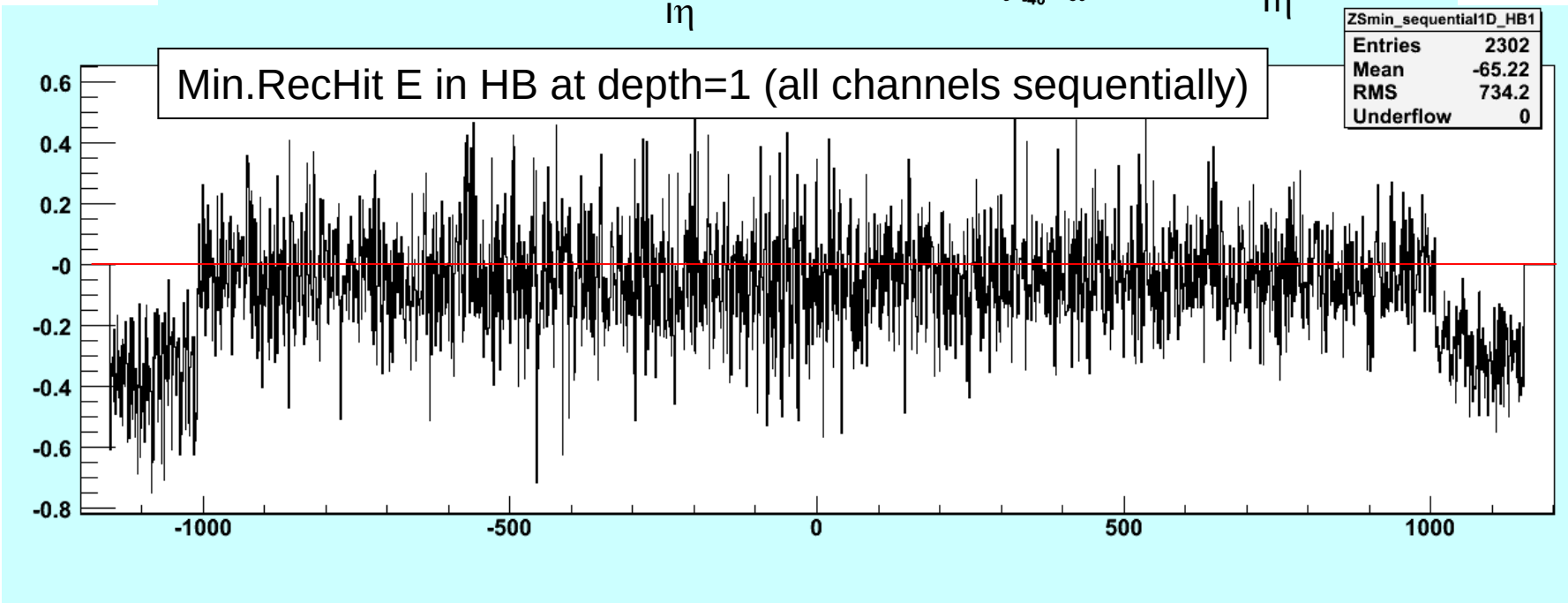
- Current (CMSSW_2_0_0) scheme
  - Sum of two ts minus pedestals > 2 ADC counts
    1 ADC count ~ 0.15 GeV in HB
  - Logical “OR” in depth
  - More practical to rise the threshold to 3 ADC counts
- More options available
  - Independent suppression or “trigger tower OR”
  - trigger tower “OR”

More on Zero Suppression

Min.RecHit E at depth=1 (iη-iϕ map)



Min.RecHit E in HB at depth=1 (all channels sequentially)

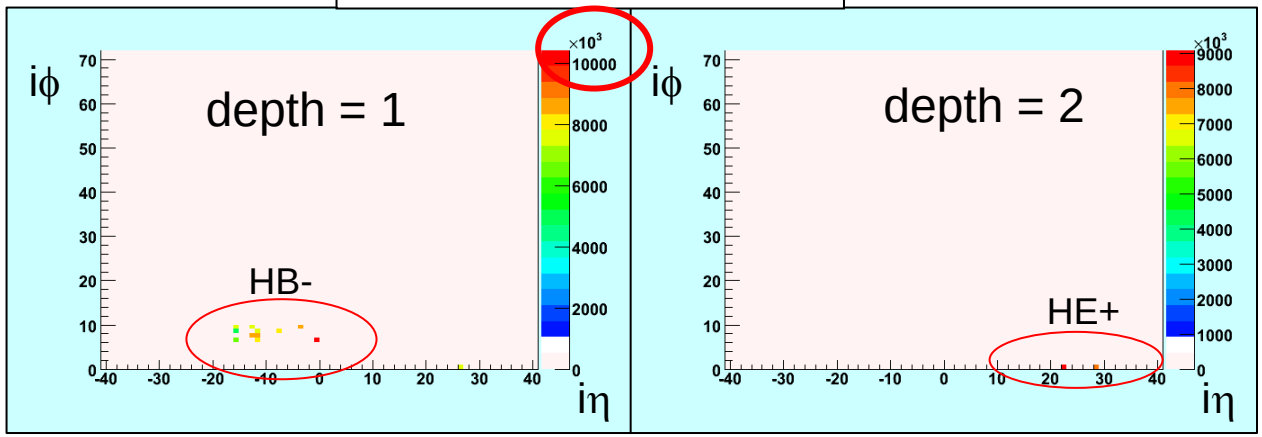


MC (2_0_0_preX) Hot Cells Issue

- Was considered as CMSSW_2_0_0 showstopper

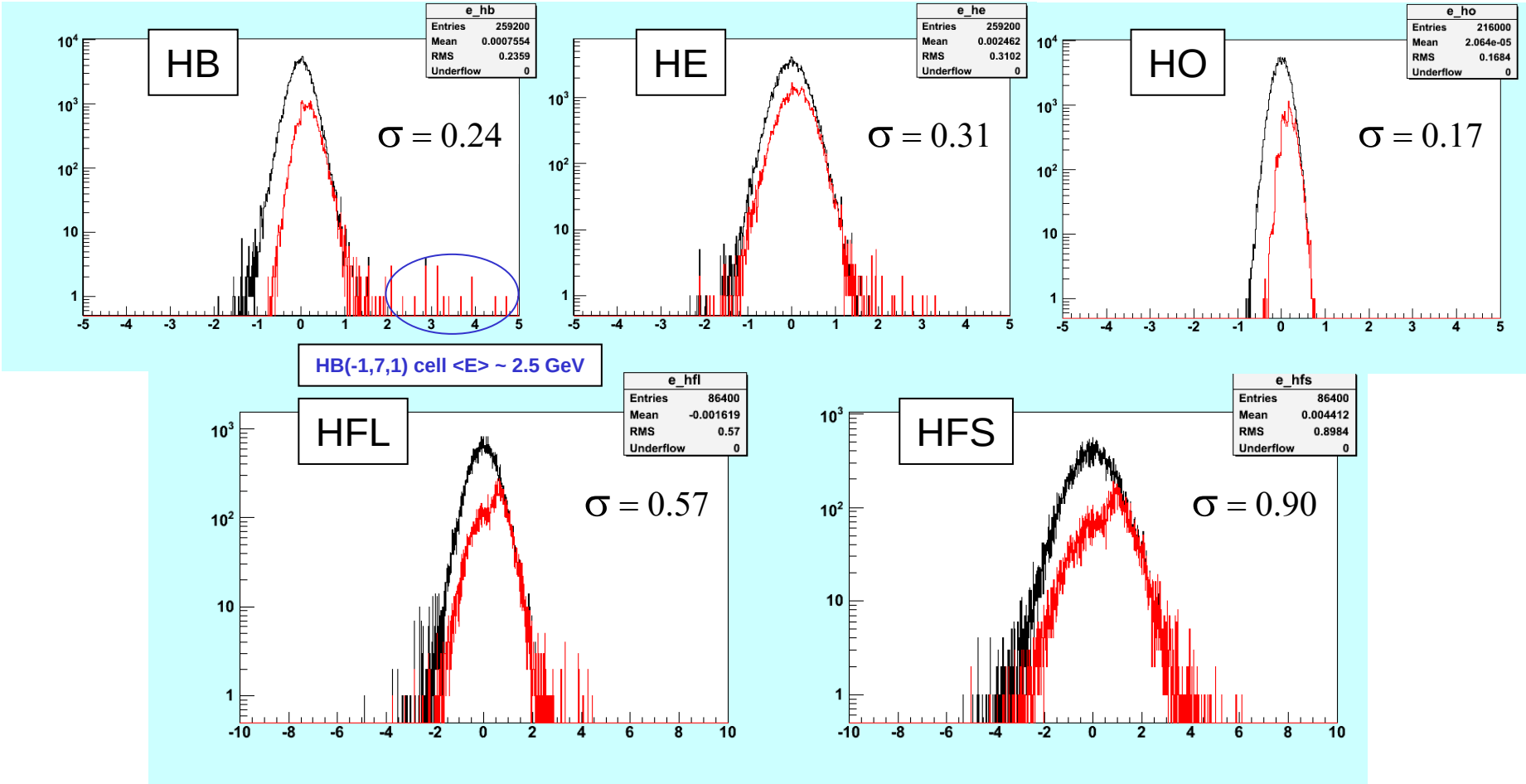
CMSSW_2_0_0_pre5

- HCAL Validation: noise (only) map of RecHis energy (with ZS level=1) 1k ev



- Investigation revealed a two-fold issue
  - Not well defined pedestals and noise for some dozen of HB/HE cells, so that noise covariance matrix is not positively defined with off-diagonal elements >> diagonal ones
  - The absence of both notification and protection in the noise evaluation code
- Fixed (to major ext.) by setting a code protection

Current MC (CMSSW 2_0_0) Noise



No ZS → ZS (2 ADC counts, current default)

Noise Occupancies

- Reconstruction group recently required to reduce the size of the HCAL RecHits collection, as it was bigger than ECAL one in 1_8_0
- 2_0_0 estimates (with new Conditions)

Subsystems occupancy breakdown (%)

ZS	level=1 (former)	level=2 (current)	level=3 (next ?)
HB	57	19	2.8
HE	78	39	9.6
HO	49	13	1.3
HF	75	30	4.5
mean	65%	25%	4.7%
	5860/9072	2290/9072	428/9072 - stored RecHits / Total

Problematic Cells Evaluation

- Cell status evaluation based on the data Digi
  - Jeff Temple (Maryland) - link to the talk
- Several types of the hot cells detection
  - Cells above certain thresholds
  - Largest-energy cell in each subdetector
  - “Outstanding” (energy >> neighboring) cells
  - Large negative energies in the cell
- Several types of the dead cells detection
  - Sum of ADC counts = 0
  - “Inversed outstanding” (energy << neighboring) cells
  - Persistent “cool” cells

Problematic Cells Treatment

- Cell status to be put in the DB
  - Framework with status word exists (Radek Ofierzynski)
- Usage of the cell status
  - more – in the talk of Anton Anastassov tomorrow
  - Probably technically best in CaloTower formatting
  - But “corrected” RecHits collection might be needed
  - Ecal-like “compensation” for the cell (switched off as dead or hot) using neighboring cells
- Adjustment of parameters on the data and possibly MC studies needed
  - For instance: threshold to declare the cell as “hot”